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FLUID DRIVES---Something

By ROBERT F. SEGNA

Many industries in our modern civilization are today facing their "last great frontier". Science and human knowledge have made such great advancements in the last few decades that almost all the major imperfections have been eliminated from our mechanical equipment.

Engineers are of the opinion that the United States Automotive Industry is now facing its last great revolutionary change. The struggle of transmissions is the most active sector on this, industry's most competitive front.

When this dream comes true, the motorist will drive in an automotive Utopia. He will only have to step into his car and press the starter. The engine will

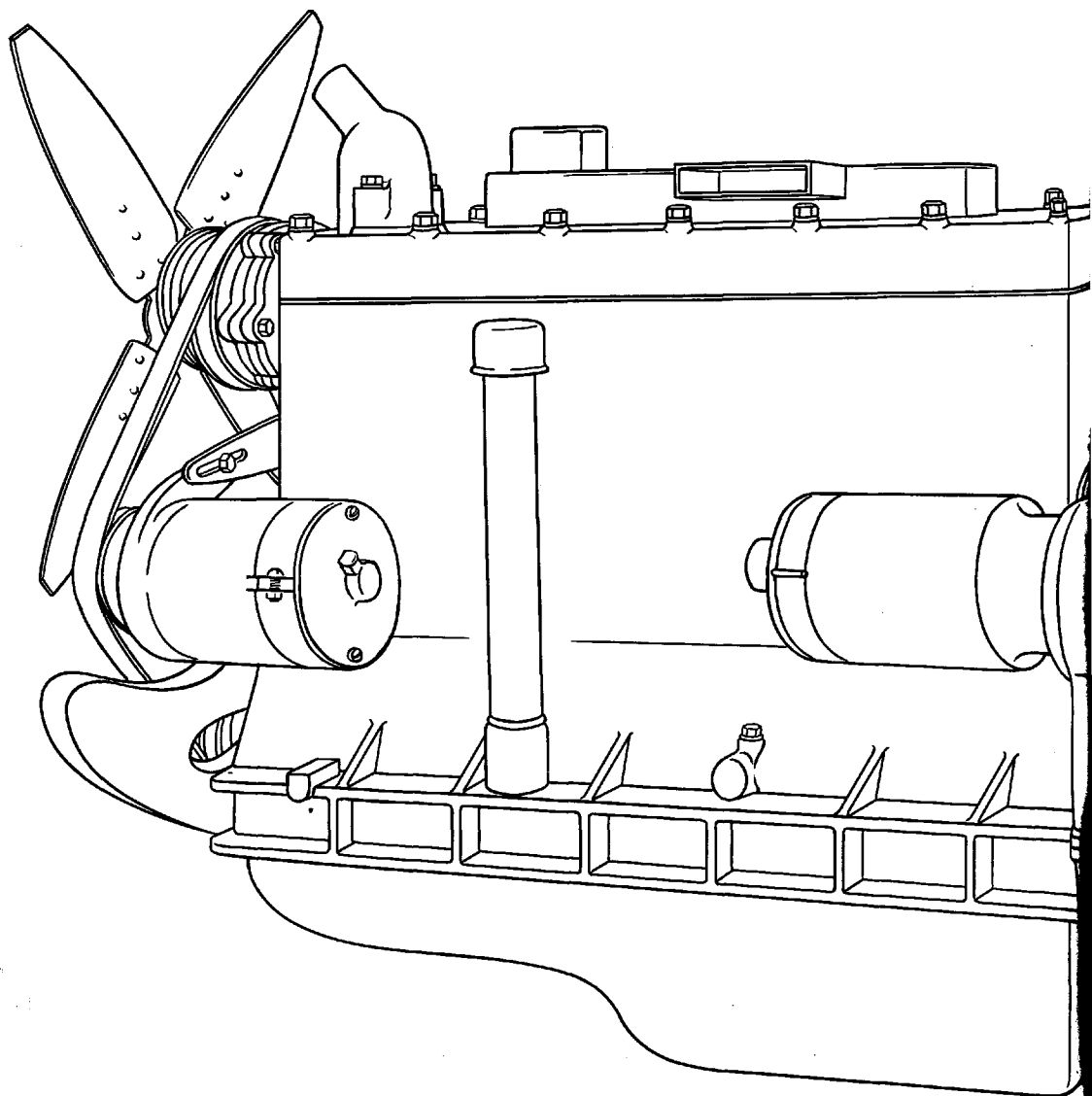
turn over comfortably. He steps on the accelerator and the car glides away like flowing oil. The car picks up speed without "feathering" the clutch, or "pumping" the gear stick, and without his doing more than pressing the accelerator, the car hits a steady clip. A traffic light brings him up as his foot presses the brake and the engine throttles down to a waiting purr.

The Hydraulic Transmission, which now occupies the liveliest portion of the experimental departments in the large designing offices of the industry, threatens to run the present conventional mechanical sliding gear shifts into obsolescence. The chief reason for the optimism about this new arrangement is primarily because it offers complete automatic transmission with a unit less complicated than exists in the present system.

The Chrysler Fluid Fly-wheel and its position in the power transmission system.

The conventional clutch and transmission can be seen behind the fluid unit.

Upper right shows the disassembled parts of the unit.



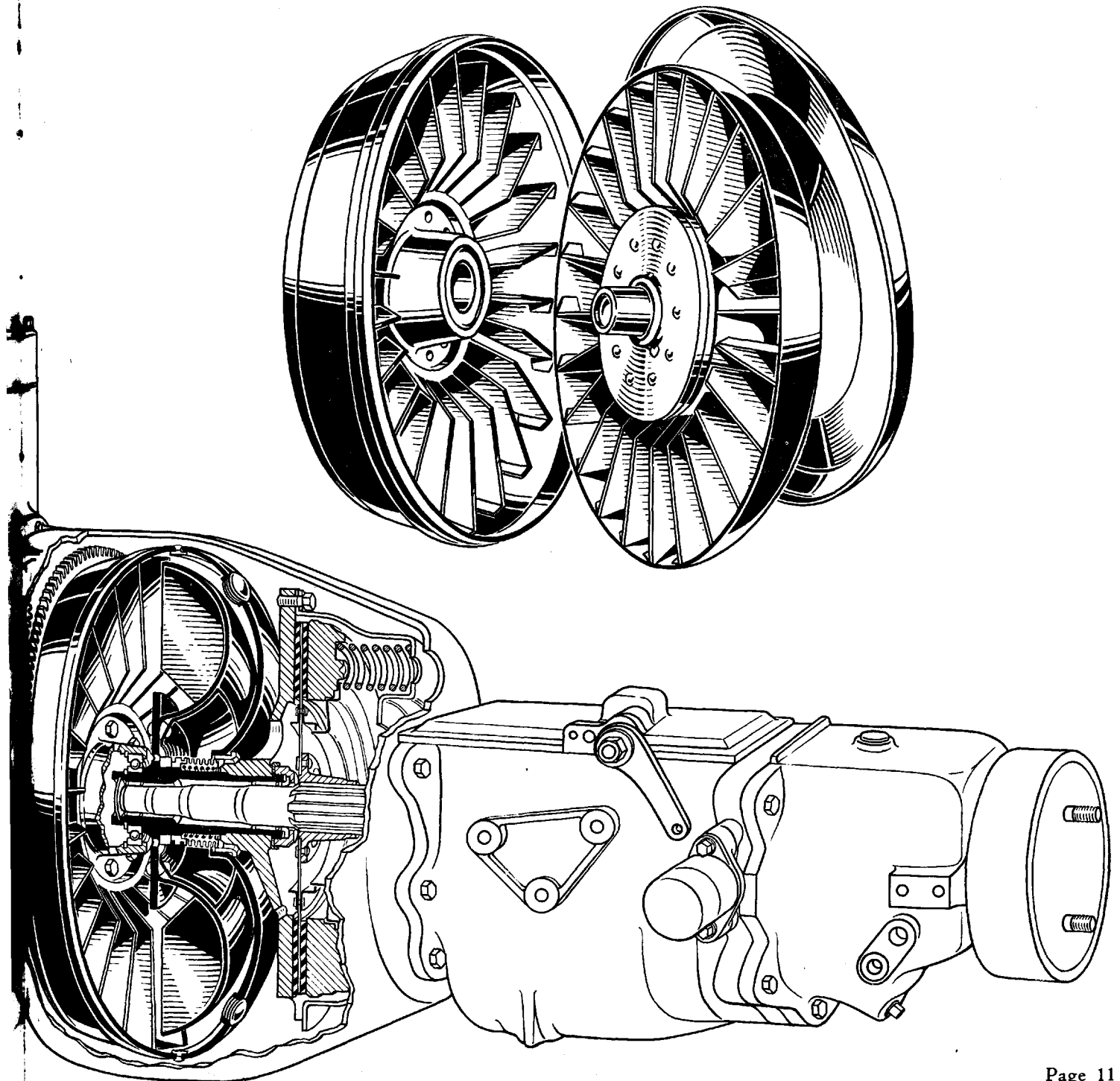
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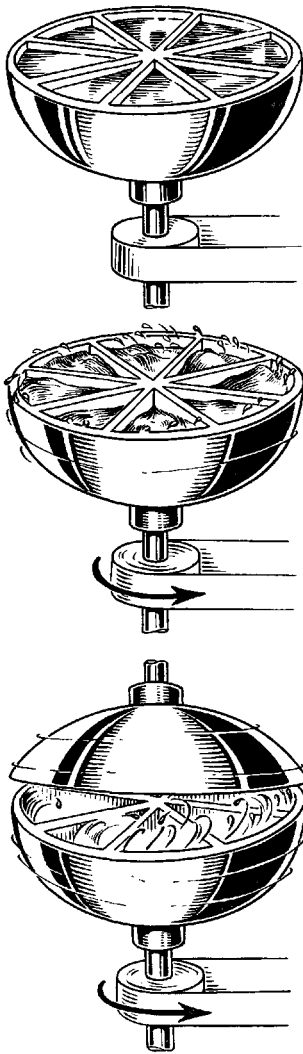
The transmission is the very heart of the internal combustion engine. A gasoline engine has a congenital weakness when throttled down which is an inability to exert enough torque through the drive shaft to overcome the inertia of the car. Consequently the transmission must do the job of adjusting the torque of the engine to the required torque of the wheels.

This adjustment of the engine speed, which is high, to mesh with the stronger twist on the driving shaft is called the multiplying torque. So far, the U. S.

gasoline engine has no feasible device to adjust the job automatically and with top efficiency.

Panhard and Levassor devised the mechanical sliding-gear device, that turns almost all the automobiles, about fifty years ago. The system is very crude but as Panhard explained when he presented it, "It works." Several gear wheels step up the torque from the engine and change it into a slower, stronger twist on the propeller shaft. A clutch or torque switch allows for the manual engagement of the different gears. The gaps





The Grapefruit idea of the Hydraulic Transmission.

1. One-half filled with water . . .
2. . . spins and centrifugal force sends water upward and outward . . .
3. . . striking vanes of second half and driving it nearly as fast as the first.

between the fixed speed ranges of the respective gears produces wasted power and gasoline. If it is not run properly, this system can be much abused and this is exactly the way it is treated by many drivers. Jerky transmission of the torsional vibrations and shocks are very noticeable on our cars today.

Manufacturers have cut gears with microscopic precision, worked out synchronizers, constant mesh and helical gears to overcome this undesirable feature, but it still persists. Many experimental projects in the laboratories have been tested and patents issued on belt transmission, friction disks, grooved wheels, rollers, chain drives, ratchet designs, centrifugal force devices and many other ideas that flooded the patent offices.

The only arrangement that has approached the answer to smooth starting in the mass production assembly lines is the planetary-type transmission of the Model T Fords. In the Borg-Warner overdrive and other advanced forms, the planetary transmission is coming back in more improved style. The 1937 Oldsmobile had a four speed semi-automatic planetary transmission in which gears are shifted at various speeds by oil pressure. Hudson also used the electro-vacuum shift developed by Bendix.

These systems only exhibit the well-known propensity of accessory mechanisms for getting out of order. This feature alone proves unpopular among motorists because so few repair men understand the complex arrangements and immediate repairs are often impossible.

The Hydraulic Transmission affords the simplest answer to the many complications of the other numerous systems. It allows engines to operate in their efficient range although the device does not multiply the engine's torque. The transmission of power through fluid instead of through the usual mechanical assembly features this system of conveyance.

Like many other mechanical devices that are being introduced today, the Hydraulic Transmission is not new. It was devised by Dr. Foettinger at Hamburg, Germany, in 1905, to act as an oil cushion against powerful thrusts of Diesels that were cracking the crude gears of the early days.

Some engineers explain that he received his idea from two grapefruit halves that were served to him for breakfast one morning. Others claim it occurred when he accidentally faced two electric fans together, one running and one not. They could both be correct because his original device resembles two grapefruit halves, and he used light oil about the consistency of kerosene for his fluid medium instead of air.

What he really achieved was a centrifugal pump which moves oil in a continuous circuit. It starts from the center of the driver and is swirled to the periphery, then to the periphery and center of the driven vane. All the energy and power is thus transmitted through a liquid medium.

Foettinger discovered that it worked best at constant speed. To secure multiplication of power necessary to move the car up a steep hill or out of mud, he hitched a flywheel to a conventional geared transmission and shifted for the extra power as needed. Later, he dispensed with this by arranging several sets of vanes in the driven half of the device, interposing sets of "stator", or non-whirling, vanes between them after the manner of a multistage steam turbine. He called this arrangement the "hydraulic torque converter".

It received its first commercial use in England in the Daimler Car and Leyland Bus, and has been used extensively in Europe and Canada since 1930.

Why the automotive industry in the United States has been holding it up involves a complexity of economic obstacles, efficiency equations, consumer uncertainty and plain engineering intractability. Stripped of its technicalities, it all means that the American engineer has been watching European efforts at interposing the cushioning and shock absorbing effect of a liquid connection between engine and the wheels, and have decided that the "bugs" are sufficiently in control for volume production. They have finally persuaded the American automobile manufacturers that now may be the time to give American drivers the greater driving ease that comes as an additional liquid-drive dividend.

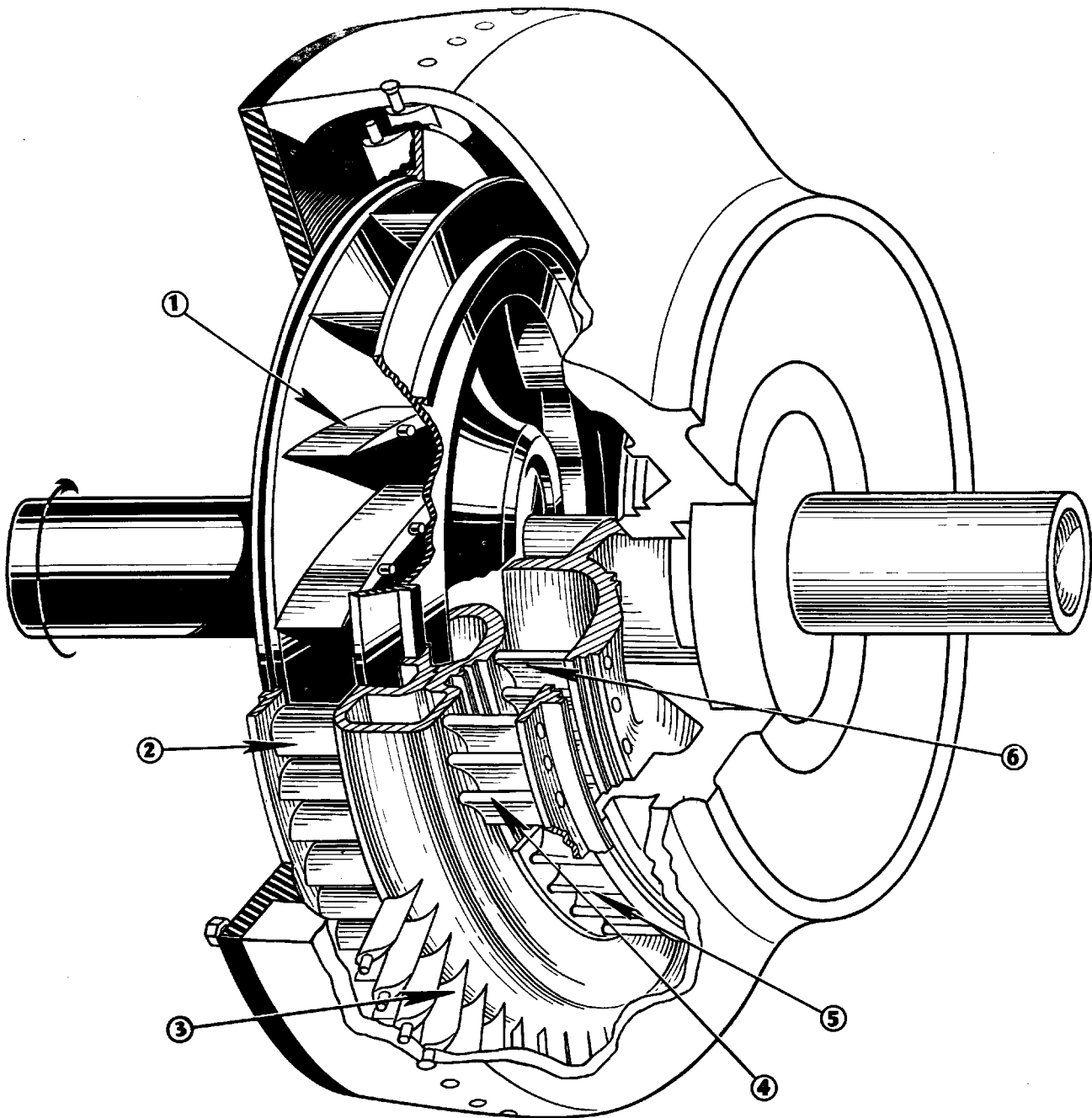
In our country, the two types originally devised by Foettinger are used by the different factions in the industry. Chrysler and A. C. F. are using modified forms of the flywheel-gear-box combination while the Yellow Coach Company sticks to the torque converter.

Chrysler's development has been led by their chief transmission engineer, Carl Neracher, who has spent some twenty-five years as a specialist with automobiles. Although the principle is relatively simple, the mechanical arrangement has presented a fistful of tough engineering and production problems. The composition of the wheels and housing of the transmission was the first problem that was encountered. The English models used cast aluminum but it cracked under the powerful U. S. engines and was rather expensive for mass production. Forgings were out of reason for

the modern assembly line. The metallurgists tried many mixtures for the castings, but none proved successful.

Finally they had to use stamped steel welded units which were able to stand 9,000 revolutions a minute and since this is beyond the present day auto speeds, it was the only satisfactory method available. It proved difficult to work with at first because each fin had to be spot welded, totalling 138 welds on each unit. Recent strides in the spot welding technique finally have enabled the industry to perform this job in an efficient production manner.

They have now speeded up the assembly production until they can now turn out 500 units a day and 5,000 with more tooling equipment. Last year, Chrysler introduced "Fluid Drive" on their Custom Imperials



The Yellow Coach Torque Converter.

(\$2,600 to \$2,800) and optional at \$150 extra on the regular Imperials (\$1,250 to \$1,500).

The manufacturers must be sure of the project before laying out from \$4,000,000 to \$6,000,000 for tooling to make this great change. About 2,000 of these Chryslers are now on the road. The Chrysler engineers have already discovered that it allows for the use of a lighter transmission which means less cost and wear on the transmission.

So far the consumer reaction has been encouraging because it is a tangible experience. The oil pocket (requiring one-half pint of oil per year) damps torsional vibrations and shocks so that the difference in driving quality is promptly apparent. As a result, the car gets off with satin smoothness from any start. Deceleration slows the car with pneumatic ease. Extra gear shifting is only necessary on steep grades or in reverse. There is definitely no stalling at traffic lights and other quick stops. The getaway is made by opening the throttle wide and the automatic overdrive may be engaged when sufficient speed is reached. A low gear for a burst of speed may thus be obtained by depressing the accelerator to the floorboard.

Idling at the traffic light at about 350 revolutions per minute there is insufficient slosh of oil to set the runner wheel moving. This means that the slip is 100%. Immediate acceleration snaps the motor up to 1200 revolutions per minute (about 25 m.p.h.) and reduces the slip to 6% and finally 0.5% as speed is picked up. The slip is then due to the power lost in friction. Again when the car is brought to a stop in high gear the action is reversed.

Some engineers argue that this arrangement cuts down efficiency because the fluid coupling is a gas consumer. They also claim that the high selectivity of the torque at which it operates most efficiently with constant slip characteristics makes ideal operation rare. Small slip, they say, prevails only on the level road and not under most driving conditions.

Chrysler engineers answer by declaring that the slip loss is counteracted by the loss from the increase in motor speed and gas consumption in low gears under the difficult driving conditions for the mechanical gear, and actual test proves that the difference in economy losses is negligible.

Smoothness in the ride and the consequent decrease in wear and repair costs more than compensate this loss in operation efficiency. Actual test proves that the life of all parts are increased 60% by "Fluid Drive". The elimination of the clutch is also very important and the safety factors such as the skidless traction on icy roads renders more advantages to the system. Regardless, the arrangement needs some form of transmission to multiply power, and as a result, the flywheel-gear-box has been added.

In their buses, A. C. F. mounts the engine under the floor with the flywheel and three-speed transmission directly attached. A new pneumatic control developed by Westinghouse and Bendix consisting of a small lever under the steering wheel is the only thing necessary for the power "shift". The accelerator must be released but this momentary slowing of the engine

permits the gears to change automatically without shock or jerk.

The Yellow Bus offers a more complete approach to the entire problem of multiple torque. Only a small handlever for forward drive instead of the numerous gears is necessary in their arrangement, and no clutch or gear shift is used, only the brake and accelerator. This set-up is more difficult to understand than to drive.

The motor turns a centrifugal pump wheel throwing the fluid against a set of runner blades. So far it is the same as Chrysler's. But the cycle does not finish here. The liquid passes through these blades, is deflected by a fixed set of blades in the housing and is directed to another set of blades on the runner. Whereupon it drops to the center axis and recirculates to the pump.

In the "Fluid Drive", the power of the motor not absorbed by the runner is lost in friction until constant speed of both is reached. In the turbine type, the power not absorbed in the first set, is utilized by the second set instead of being wasted as slip, and the unused power in the second set is absorbed in a third set. The fixed blades which the fluid bounces from are reaction points at which power is redirected. The final result of this system is a larger part of the torque from the faster engine being absorbed in the transmission. It has the effect of a torque multiplying gear box.

The tendency of the first set of blades is to catch up with the speed of the impeller, just as with the runner in the fluid coupling. As the first set gathers speed, the second and third series get less and less load until the one to one ratio is approached between the impeller and runner, and from then on it is operating the same as "Fluid Drive".

Colonel George Green, the Vice President of the Yellow Coach Company, is leading their development of the "Hydraulic Drive". He has been designing buses since 1902. The Company is working in collaboration with the Spicer Manufacturing Company of Toledo, Ohio, under Swedish patents and it has cost \$150,000 to develop so far. The torque converter has a tendency of high efficiency at low speeds against the fluid drive high efficiency at high speeds. So, Yellow developed an ingenious automatic roller that now switches the engine from the turbine to direct drive at high speeds.

Actual tests show a 5% loss in gasoline operating economy of the "Hydraulic Drive", but they also show a 30% gain in Diesel operating economy.

"Hydraulic Drive" removes some of the strain on the bus driver and offers more riding comfort to the passenger. Since the bus driver must make change, collect fares, issue transfers, open and shut doors and watch traffic, any relief in driving is a help in human driving efficiency.

The torque converter is expensive because it is almost a hand made job, and will cost \$500 extra on trucks and buses until production is stepped up. Naturally the new process involves more cost at the

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start and a little loss in transmission economy. Another question puzzling to the engineers, is, "Just how automatic should the gear be?"

Again, some engineers think hydraulic drive is coming too late because the mechanical shift is so well established today. Psychologically, the driver likes to

feel that he has a sense of control over the gears.

The answer to this problem will soon be in the motorists-hands. You and I must decide whether we want this new improvement that engineers are offering to us or whether we shall cling to the old inefficient mechanical transmission.
